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DEFENSE SYSTEMS MANAGEMENT SCHOOL

STUDY TITLE: LESSONS LEARNED: PRODUCTION RESTART OF A MAJOR WEAPONS SYSTEM

STUDY PROJECT GOALS:

To determine the significance of problem areas associated with production restart of the Short Range Attack Missile (SRAM), including availability of missile components, compatibility of missile/carrier requirements and impact to program schedules.

To review program office planning for production restart and to summarize conclusions for use by other programs considering a similar situation.

STUDY REPORT ABSTRACT:

The purpose of the report is to provide insight into the peculiar problems that arise during restart of a weapons system after a prolonged break in production. The situation considered is the restart of production of the Short Range Attack Missile (SRAM) which will be required in the event a decision is made to produce the B-1 aircraft. The problem is significant since production of the SRAM was completed in July 1975 and restart activity in support of the B-1 would not occur until 1977 at the earliest.

The report includes a discussion of Program Office planning. Initial and follow-on planning is compared and changes in emphasis and assessment of risk are noted. Planning areas covered include mandatory and desirable configuration changes, performance improvement, nuclear hardness and warhead requirements. Impact to program cost and schedule is also discussed.

The report concludes that:

Production restart planning must be built around system requirements;
Production restart planning should be concerned with reproducing the existing design;
Planning effort to improve system performance is not productive.
Production restart will involve a great many unknowns; and
Detailed planning is necessary to resolve restart problems.

The basis for data used in the report was Program Office planning documents, contractor study documents, interviews with SRAM and B-1 Program Element Monitors and interviews with Program Office personnel.

The report will be of interest to individuals involved in program management who are considering restarting production of a major system.

KEY WORDS: Production Restart. (AIRCRAFT B-1 INDUSTRIAL DYNAMICS) MATERIEL PRODUCTION (PRODUCTION CONCEPTS MISSILES PROGRAM MANAGEMENT) WEAPON SYSTEMS COST CONTROL PROJECT MANAGEMENT

NAME, RANK, SERVICE	CLASS	DATE
Duane K. Hlavinka, Major, USAF	PMC 76-1	May 1976

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INDIVIDUAL STUDY PROGRAM

LESSONS LEARNED:
PRODUCTION RESTART OF
A MAJOR WEAPONS SYSTEM

STUDY PROJECT REPORT
PMC 76-1

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LESSONS LEARNED:
PRODUCTION RESTART OF
A MAJOR WEAPONS SYSTEM

Study Report Project

Individual Study Program

Defense Systems Management School

Program Management Course

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by

Duane K. Hlavinka
MAJ USAF

May 1976

Study Project Advisor
Mr. Wayne J. Schmidt

This study project report represents the views, conclusions and recommendations of the author and does not necessarily reflect the official opinion of the Defense Systems Management School or the Department of Defense.

EXECUTIVE SUMMARY

The purpose of the report is to gain a better appreciation for the working principles which underlie the operation of the weapons system acquisition process, through an analysis of an actual program office problem.

The problem considered is the restart of production of the Short Range Attack Missile (SRAM) in support of the B-1 Program, which will be required if that program is approved for production. As background, the report includes relevant history of both programs and notes that the original SRAM production was completed in July 1975. The report defines the restart problem both in terms of known component changes, required primarily because of loss of suppliers, and desirable changes, which, if included, would provide an improved version of the SRAM for use with the B-1 aircraft. The implications of a replacement rocket motor, increased nuclear hardening and modification of the missile/warhead interface are also included. Planning solutions, as defined in late 1975 and early 1976, are discussed and compared to earlier planning. Items covered include missile configuration, system testing, cost, schedule and program risk. The latter items are discussed in general terms only, since detail could not be included because of its obvious sensitivity.

The report concludes that production restart planning must be built around system requirements and should be primarily concerned with reproducing the existing design, that restart planning is not productive with respect to effort spent to improve system performance or add growth potential to the design, that production restart, by its nature, will

involve numerous unknowns, and finally, that detailed planning, with appropriate review and update to reflect new information, is central to successful resolution of the production restart problem.

ACKNOWLEDGEMENTS

I wish to thank Wayne J. Schmidt, of the faculty of the Defense Systems Management School, for acting as my Study Project Advisor and for his advice during the initial planning of the report. I would also like to thank Mrs. Marge Abernathy for her comments on arrangement of the text and for typing the final manuscript.

Table of Contents

SECTION I

INTRODUCTION

Purpose

My purpose in writing this paper is to gain a better understanding of the operation of the weapons system acquisition process through an analysis of a specific program office problem.

Problem

As a problem for analysis, I chose the restart of production of the Short Range Attack Missile (SRAM), which will be required in the event a decision is made to produce the B-1 bomber. This problem was selected for several reasons. First, I was familiar with the subject because of prior experience in the SRAM Program Office while assigned there as an analysis and integration engineer. Sec[illegible] i felt that by studying this type of problem I might aid others in as[illegible]ssing the usefulness of using completed, off-the-shelf design as an acquisition strategy during early phases of the acquisition process. Finally, upon completion of DSMS, I will be reassigned to the SRAM organization in project management and, hopefully, the insights gains will be of benefit to me in that assignment.

Method of Analysis

In considering the method of problem analysis, it should be noted that the restart of SRAM production is of future interest inasmuch as it is dependent on decisions reached by the Department of Defense and Congress

on the B-1 Program. As such, problem aspects of a production restart must be seen in a future tense and can only be anticipated in program planning. Because of this, the analysis is centered on review of planning rather than on actual events. This was done by first summarizing the initial Program Office planning with respect to areas affected by production restart. Present planning is then reviewed and the results compared and contrasted with the original plan. Because of the constraint of time, a detailed treatment of all areas could not be completed; however, management concerns have been stressed. Because of their inherent sensitivity, cost and schedule are only covered in comparative terms.

Data Sources

The basis for data used in the report was Program Office planning documents, contractor study documents, interviews with SRAM and B-1 Program Element Monitors and interviews with Program Office personnel.

Report Arrangement

The report material is arranged in five sections. Section I contains appropriate introductory remarks. Section II describes the SRAM weapon system and outlines relevant history of that program. Section III defines the restart problem in terms of initial Program Office planning. Section IV examines the present planning based on updated information and contrasts this with the program as defined initially. Section V contains study conclusions.

SECTION II

BACKGROUND

System Description

The Short Range Attack Missile (SRAM) was conceived as a strategic weapon to arm the B-52 G/H and FB-111 bomber force in the early 1970's. The SRAM is essentially a defense suppression weapon with range, speed and accuracy such that the bomber aircraft is able to "stand off" from its target while the SRAM penetrates enemy defenses. Because of the small radar cross-section and flight characteristics of SRAM, an enemy would have great difficulty in acquiring, tracking and destroying it before the mission is completed. The SRAM uses an inertial guidance system and is propelled by a two pulse, solid rocket motor. It is capable of supersonic speeds and delivers a nuclear warhead to its target. The missile is made up of payload, electronics, propulsion and flight control sections and can be mounted in the weapons bay or on wing pylons of the carrier aircraft.

Program History

The SRAM weapon system completed the conceptual and validation phases between 1964 and 1966 and entered full-scale development in October 1966. Following a successful development phase, production deliveries were made to the B-52 and FB-111 operational wings beginning in early 1972 at production rates of 15 - 20 missiles per month. Successive procurement buys followed with full production rates of 40 missiles per month achieved in late 1972 and continuing on through into 1973, 1974 and 1975. A total of 1500 missiles were produced, with the last missile delivered to the Air Force in July 1975.

Relationship to the B-1 Program

Because of the success of the SRAM system and the fact that it represented a completed, available weapon system, it was specified as the primary weapon to arm the B-1 Bomber, which had entered full-scale development in late 1970. Beginning in 1971, the B-1 Program Office funded an interface support contract to provide contractor support to the B-1 Air Vehicle Contractor and to the B-1 Avionics Systems Integrating Contractor to support the required definition of mechanical, environmental and electronic interfaces between the B-1 carrier aircraft and the SRAM missile. The contract specified a 1972 missile baseline and included provision to assess the impact to the interfaces of any Engineering Change Proposals approved for the SRAM after that date. During 1972 and 1973, the B-1 Program Office also funded the procurement of missile hardware for load and separation testing on Air Vehicle 1 and captive missile flight testing on Air Vehicle 3. The B-1/SRAM integration activity had been planned to support ground and captive flight testing in late 1974 and early 1975 in general support of a mid-1975 production decision on the B-1 Program.

At this point it appeared that the program acquisition timing of the two programs was fairly good. The B-1 Development Program was able to use residual development hardware and other existing assets from the SRAM Program for early integration testing while a decision on production options for SRAM for the B-1 could have been well su orted by on-going production experience. Also, it appeared that the test hardware and interface support could be secured for minimum cost and effort even though the future milestones for the B-1 Program were uncertain.

This situation was greatly altered in late 1973 when the B-1 Program underwent major restructure. Perhaps of most significance for the SRAM Program was the rescheduling of the B-1 production decision from mid-1975 to the third quarter, 1976. The immediate effect of this change was a decision to delay procurement of test hardware for the B-1 Program which did result in some cost increase. However, the long term effect of the delay on the eventual production of SRAM for the B-1 was not clear. The SRAM Program Office was aware of the general uncertainty of the B-1 Program and was not unduly concerned with production planning at that time. Other activities were also competing for attention, particularly the early transition of the weapon system to the Air Force Logistics Command.

SECTION III

PROBLEM DEFINTION

Early Program Planning

The SPO began formal production restart planning in late 1974. This planning had been preceded by informal discussions with the SRAM prime contractor which had come about as a result of earlier concerns for a follow-on SRAM program. In March 1974, a second generation missile had been advocated by the Program Office. This program was built around the need for a replacement rocket motor because of potential age out of the solid propellant used in the original motor. The proposed missile design was characterized by a configuration optimized for longer system life with improved reliability and maintainability and enhanced system performance. This program was disapproved by Headquarters, USAF, although the replacement motor portion was continued, in cooperation with AFLC, under the guidance of the Program Office. In mid-1974, a second effort at a follow-on missile program was proposed, this time by the new business interests in the prime contractor's organization. This version of the SRAM was essentially a complete missile redesign, incorporating a much longer range, optimized flight trajectories and a radiation homing device for terminal guidance to the target. This version of the SRAM was never advocated by the Program Office since it was a new development involving high risk technology and typified the "capability without a requirement" syndrome.

The SRAM for B-1 planning remained separate from these activities, although it suffered from an identity crisis because of the wide exposure which the two earlier configurations had enjoyed. However, the new

production planning did build upon the residual motor replacement program. The initial planning document for the production restart program was issued in April 1975. The material that follows is a summary of information contained in that document. Detail has been omitted where it does not contribute to an understanding of the Program Office approach.

Specific Production Planning

General. Production of SRAM for the B-1 will involve producing the current SRAM design as it exists today with certain component substitutions. The SRAM program has already experienced such substitutions during the present production program. Consequently, it is reasonable to expect that such things as manufacturing obsolesence, suppliers going out of business, and contraints imposed by the Occupational, Safety, and Health Act (OSHA) will necessitate numerous component substitutions prior to a production restart to support the B-1 program. Although many component substitutions will be required, SRAM operational performance, the interface between SRAM and carrier aircraft, and the interface between SRAM subsystems will be unchanged.

Production of the SRAM for B-1 should also consider component substitutions which may be desireable in light of cost and benefit trade-offs. Lessons learned, coupled with the availability of current state of the art substitute components, make it possible to improve such areas as maintainability and reliability at little or no increase in cost. Although improved operational performance is not the objective of the program, the substitution of state of the art components protects the option for improved SRAM performance should this be required in the future.

Groundrules. The plan included a series of ground rules specifying the number of B-1 aircraft to be produced, the B-1 production schedule and the structure of the B-1/SRAM flight test plan. Details of these are omitted since they are driven totally by the B-1 Program. The plan indicated that the SRAM Program would provide flight test missiles of the existing configuration from operational sources and flight test missiles of the new configuration from new production. Development test requirements of the B-1 Program would be satisfied using the existing missiles while new production missiles would be used to verify the integrity of the new design. The existing Operational Test Launch (OTL) payload hardware design would be used to secure system data during missile flight test.

Assumptions. The plan included the following assumptions:

To the greatest extent possible, SRAM activation will occur concurrently with activation of B-1 operational squadrons.

Current SRAM assets will not be transferred to the B-1 force.

The configuration and specifications will be the same as current SRAM except for configuration changes as noted.

Except for improvement in missile range, which is presently available through software changes, improved operational performance is not an objective of the program.

External interface and the internal interface between subsystems will be unchanged.

DSARC III approval will be required to initiate the program. A DSARC III review for new production of SRAM will occur concurrent with or subsequent to the B-1 DSARC III review.

The requirements for SRAM facilities and ground equipment to support B-1 deployment are assumed to be similar to those verified during development of the SRAM B-52G/H and FB-111 weapon systems.

Required Changes. The following component substitutions are required:

Terrain Clearance Sensor Antenna Window. The manufacturer of this item has phased out their product line for this item and are not interested in a follow-on contract. In addition, the material supplier has discontinued production of the T-5 teflon used to fabricate the window. Effort is presently underway to determine if silicone is an acceptable substitute material for teflon in this application.

Command Destruct Time Delay Relay. The supplier of this item has discontinued his military product line and has no capability to produce this item. Qualification of a new supplier will be required.

Components of the Missile Computer. The supplier of the hybrid switch used in the missile computer has terminated production of this item. Production of computer card edge tab connector lubricant was discontinued by the supplier over a year ago. In addition, the manufacturer of the computer estimates that about 35 percent of the computer parts are unique to SRAM and subject to obsolescence.

Linear Shape Charge Used for OTL Command Destruct. OSHA has imposed constraints on the production of adhesive materials used in the manufacture of this item. This material is not expected to be available

for follow-on SRAM production because of the small quantity of material required and the severe production constraints imposed by OSHA. Design modification to allow use of a different bonding method or material is required.

Digital Data Register Used in the OTL. The basic logic design for this item was developed in 1966. Since that time, advances in IC technology have caused production line changeover to state of the art components. Therefore, it is questionable whether the logic design will be available from sub-tier suppliers for use in follow-on SRAM production.

Rocket Motor Nozzle. The rayon fabric from which carbitex and the carbon phenolic components and silica-phenolic elements of the nozzle are made is no longer produced. An alternate or equivalent material must be located.

Desirable Substitutions. Substitutions which are desirable in light of the potential benefits are:

Missile Computer. It was previously noted that problems with computer availability would be encountered since the hybrid switch, lubricant, and 35 percent of the computer parts would not be available for follow-on SRAM. Also the current computer has little growth potential since there are currently only 15 unused words of memory available. Indications are that a new computer would provide a greatly expanded capacity with only a minimum development effort required. A breadboard of the computer processor has been in operation at the supplier's facility for about two years. The incorporation of the breadboard circuitry into 9 LSI IC's has been accomplished and was put in an operating brassboard configuration in March 1975. The primary effort for the follow-on SRAM would be to

repackage the processor to SRAM envelope requirements and to package the proposed input/output circuitry. The input/output will use state of the art technology and existing supplier designs. The expanded memory of the new computer could be used for such purposes as missile self-test and trajectory shaping and optimization. Consequently, a new computer would enhance maintainability, increase the operational flexibility, and have sufficient excess memory for future growth.

Gyro Stabilized Platform. The current SRAM platform is part of the supplier's KT-70 product line and shows commonality with other platforms of the line in the areas of design, manufacture, and test. For logistics reasons and to preclude unnecessary risk to performance, tl SRAM platform has remained essentially unchanged during production. However, there are reasons to consider possible design changes in a new production run.

The basic KT-70 product line has changed to accommodate improvements in materials, processes, etc., desired by non-SRAM customers. Additional changes to the product line will occur as the supplier changes production capability to accommodate the recently developed SKN 2400 system. When this occurs, and upon completing present SRAM production, the supplier is expected to purge much of the capability to make the present SRAM platform.

The new guidance systems are expected to be the high volume, standard product line of the manufacturer during the period in which the follow-on SRAM would be produced and there would be substantial cost advantages to using this product line. In addition, most of the manufacturer's resources for product improvement are delegated to the standard line.

The new guidance systems have a number of reliability and maintainability advantages ranging from rapid replacement of inertial

components to the greatly reduced part count of the platform electronics. No reasonable amount of modification to the existing SRAM guidance system could provide this capability.

The new guidance system candidates appear to be compatible, to a large degree, with test equipment in the Air Force inventory. One of the proposed new designs is in use on the F-15 program and the other appears to be compatible with much of the existing SRAM depot check-out equipment, based on a first look analysis.

The SRAM Program Office is presently investigating the development status of alternate inertial components. Although the investigation is not complete, it is anticipated that the SKN 2400 will require some redesign for SRAM application in that it does not meet the present shock loading requirement of 20 g's. Design work will be needed to beef up the SKN 2400 and associated structure to increase the present load tolerance of 15 g's.

Control Guidance Electronics (C-GE). The guidance electronics in the C-GE would require change to support a new platform. This change would consist of replacing five or six of the existing circuit boards with two new circuit boards. The electronics is developed but must be repackaged for SRAM application. A potential improvement in reliability is available with the new electronics because of the greatly reduced part count.

Telemetry Battery Cells (Part of OTL). Manufacturing problems have caused the lot acceptance rate of these cells to be very low. It is expected that the cost of these cells would be very high for a follow-on production program; therefore, a cell of new design should be provided.

In addition, extended battery life could be obtained with redesigned cells.

Command Destruct Detonators (Part of OTL). This detonator design is unique to SRAM and production costs are increasing. Less expensive detonators presently in use by DOD could be substituted for these detonators, if requalification is accomplished. It is expected that this would cost less than restarting the current SRAM detonator production line for follow-on SRAM.

Cold Gas System for Flight Control Actuator Assembly. Based on current SRAM program experience, severe production problems are anticipated if the present cold gas system is produced by the present supplier for the follow-on SRAM. Poor configuration control, late deliveries, requests to allow material substitutions, and high costs have been encountered with this supplier. These problems could be alleviated by modifying the design to reduce manufacturing complexity and/or by changing suppliers. Improvements in reliability and maintainability would result from a simplified system.

Verification Testing. The SRAM Program Office recognized that verification testing would be required to assure technical integrity of the new configuration and planned to accomplish the testing in three phases. First, a software development program was planned to verify system integration of new components. Second, a test program was planned using ground test missiles to demonstrate the compatibility of newly qualified components with the total missile system. Finally, the Program Office had planned a missile launch program to demonstrate critical missile performance functions which were only shown analytically during previous missile ground tests.

Other Considerations.

Rocket Motor. As noted earlier, the Program Office in conjunction with AFLC, had proceeded with a program to provide a replacement rocket motor for the SRAM on a schedule to meet potential motor age-out consistent with the need for maintaining SRAM in the operational inventory. The replacement motor was to be interchangeable with the present design, compatible with current operational and support equipment and meet all performance requirements of the present missile system. This program would require qualification of a new motor supplier since the supplier for the existing motor design had gone out of business at the completion of the last SRAM production buy. Since the replacement design was to be available approximately two years prior to first missile production for the SRAM for B-1, the Program Office planned to use the replacement motor design with the new missile configuration.

SRAM Warhead. The SRAM planning noted that specific certification requirements regarding use of a nuclear warhead with the new production configuration were unknown but that the Energy Research and Development Administration (ERDA) had been contacted in order to provide inputs to the SRAM for B-1 production plan. The Program Office planning did note that they had learned through informal discussion that the current warhead design might not be produced for a follow-on SRAM build because of an ERDA recommendation to incorporate improved safety features in all new warhead production.

Nuclear Hardness. The Program Office was aware that a comparison of SRAM and B-1 nuclear hardness specifications revealed generally higher requirements for the B-1. Since SRAM is to be a primary weapon of the B-1,

the Program Office noted that it might be desirable to harden the SRAM to B-1 nuclear hardness levels. No information was available at that time to determine the cost of hardening critical SRAM components, particularly a new platform and computer, to the B-1 hardness levels.

Cost. The Program Office planning included cost numbers based on contractor estimates of production cost of the total number of missiles planned for the B-1 program. The cost detail has been omitted here because it is not needed for the purposes of this paper. However, it should be noted that the cost data was based on the assumption that cost experience accumulated during the original production of the SRAM was valid and that the non-recurring costs for substitute components would be the same as those for current components. This latter assumption was based on comparing the projected costs of the current missile inertial platform and computer, based on historical data, with a prime contractor/vendor cost estimate for a new platform and computer. The results showed essentially the same cost. The validity of this assumption was to be investigated by refining the prime contractor/vendor cost estimate and by analyzing other component substitutions.

Schedule. The Program Office planning included consideration of start-up times based on review of specific vendor requirements and noted that the pacing items would be the missile computer and inertial platform which require 34 and 36 months, respectively. The schedule for flight test missiles was compatible with the B-1 flight test program. With respect to delivery of operational missiles to the B-1, the Program Office felt that the required schedule might be difficult to meet, based on actual need dates for the B-1. However, the Program Office noted that, in

their opinion, the B-1 schedule was based on an unrealistic assumption concerning early use of the deployed system by the user.

Risk. The Program Office planning indicated that the new SRAM production would have certain risks associated with it, primarily because of the new computer and platform. The risk was not attributed directly to hardware development since it was felt that the new elements would have been already developed prior to application to SRAM. The risk was associated with repackaging the hardware to meet SRAM requirements and any additional development associated with tailoring the design to unique SRAM specifications. The plan indicated that it would also be necessary to identify the impact of the new hardware on the existing system, particularly the software, so that changes could be developed and implemented. The Program Office felt that there would be low risk to cost and schedule in incorporating these changes. With respect to nuclear hardness and warhead interface requirements, the plan indicated that these areas presente unknown risks and would require further evaluation. If the new production configuration must be hardened to the B-1 nuclear hardness levels, the Program Office saw this as a significant cost risk. The potential risks involved in warhead certification with the new missile or with a new warhead design included potential schedule slip due to a delay in warhead availability by ERDA. This, in turn, would impact missile schedules by delaying missile/warhead interface development. The Program Office felt that they could not assess the potential significance of these latter risks with the information available to them at that time. The risk of the motor replacement program was not addressed.

Summary

The production restart problem has been defined in detail for two reasons. First, the detail provides an understanding of why substitution of certain components would be mandatory prior to any new build as well as an appreciation for the type and complexity of the components affected. Second, the detail provides insight into the planning rational with respect to desired configuration changes. In this regard, the Program Office emphasized building a better missile with improved reliability and maintainability, and with a built-in option for improved performance. Such a program seemed to be low risk, although unknown risks associated with hardening and warhead change were noted. The initial planning seemed to emphasize what could be built as opposed to what needed to be built.

SECTION IV

DISCUSSION

In Chapter IV, the early planning and assumptions of the Program Office with respect to restart planning are compared to study results and actual events which have occurred from April 1975 to date. The material is based on review of contractor studies and discussions with the Program Office and the SRAM Program Element Monitor.

Significant Events

Configuration Studies. In September 1975, after informal discussions with the contractor, the Program Office funded a configuration definition study contract with the prime contractor. The study was to define a baseline missile configuration based on the prime and subcontractor's estimates of their ability to produce the current configuration in the 1980 time period. The study considered such things as mandatory design, process or material changes, the impact of mandatory changes, start up requirements, effects on second tier suppliers and requalification requirements. The prime and subcontractors were also to recommend alternate designs of current hardware which would result in lower costs and reduced maintenance. Baseline costs were to be included.

The study was not completed at the time the data was reviewed. A final report will be submitted to the Program Office on 30 April 1976 and it is possible that certain studies will be continued to refine results in some areas. However, an informal summary shows that the mandatory changes proposed in the earlier planning can be accomplished with low risk to the

program. With respect to desirable changes, it appears that such changes are attractive at the component level. Above the component level, there is more cost benefit to be gained from improving component design by changing tolerances, seals, or valves, for example, than by integrating and qualifying a substitute system.

The Program Office had listed the missile computer and inertial navigation unit as desirable substitutions. Substitution of neither component could be justified, based on cost benefit trades; however, a new computer will be required because of nuclear hardness requirements. The criteria used in cost/benefit comparisons were reduction of life cycle cost through cheaper production costs or increased reliability of the component being considered.

Nuclear Hardness. Subsequent to the initial production planning, the Program Office discussed nuclear hardness design philosophy with the B-1 Program Office for the Government Furnished Equipment to be used on the aircraft. Then, in July 1975, the Program Office contacted the Air Force Nuclear Criteria Group and requested that they study the SRAM weapon system as used on the B-1 bomber and provide a recommendation on hardness levels. The Nuclear Criteria Group agreed to do this and, after appropriate pre-planning, advised the Program Office to provide additional study information. This was done by adding nuclear ha.dening studies to the configuration studies which were begun in September 1975. The analytical studies were completed in February 1976. Tne Nuclear Criteria Group participated in these studies and will provide a recommendation to the Program Office in June 1976 on hardness levels for the new production configuration of SRAM.

Again, although final results are not yet available, tentative conclusions can be drawn based on informal discussion with the Program Office. Several levels of hardening were considered by the Criteria Group, including the B-1 nuclear hardness level and values both above and below that level. It appears that the cost delta's to go to the B-1 or higher hardness level will not be significant when compared with start-up and hardware procurement cost of the entire missile system. However, the analysis shows that the best approach to system hardening involves use of circumvention techniques, which require additional computer memory. Since the present computer does not have excess capacity, a new computer will be required. The use of a new computer will provide an indirect benefit since the increased memory could provide space for other functions, such as missile self-test.

SRAM Warhead. In June 1975, the Program Office met with ERDA representatives to discuss the impact of warhead flight testing on the SRAM for B-1 production planning. Nothing conclusive came of this exchange. On the one hand, the Program Office could not point to an Air Force decision on either B-1 or SRAM production to use in planning a program with ERDA. On the other hand, ERDA was hesitant to commit to support planning because of anticipated direction by DOD concerning warhead development for the Air Force Air Launched Cruise Missile (ALCM) and the Navy Sea Launched Cruise Missile (SLCM). (The latter system has since been designated as the TOMAHAWK.) ERDA felt that the proposed warhead development program for both of these advanced development systems would take priority over any new production of the original warhead design for follow-on SRAM.

The latter issue dominated warhead/missile discussions between ERDA, the Program Offices and higher headquarters during the last half of 1975. In February 1976, ERDA was directed by DOD to begin a warhead development program in support of the ALCM and TOMAHAWK missiles. However, at the time the data was reviewed, neither the B-1 or SRAM Program Offices had received definitive direction with respect to the warhead configuration to be used with the follow-on SRAM. This will result in some degree of delay in defining the missile/warhead interface, which in turn will impact the technical planning for the new missile configuration. The electrical interface between the missile and carrier could also be affected, depending on the nature and degree of changes to the missile/warhead interface. Changes to this latter interface would raise questions as to the interchangeability of missile configurations with the B-1 aircraft. The present missile/carrier interface is defined in terms of the existing missile configuration and is being incorporated as part of the B-1 design. Any change to this would limit the B-1 carrier to use of the follow-on missile configuration only without benefit of interchangeability with the existing SRAM fleet.

Rocket Motor. The replacement motor program is on schedule and will begin the development and supplier qualification phase in June 1976. In February 1976, in order to obtain an additional technical perspective, the Program Office asked the Aeronautical Systems Division Advisory Group to review the technical design of the replacement motor. This has been completed. The Advisory Group concurred in the over-all technical direction of the program, although they noted that a solid burn rate catalyst would have been more desirable than the liquid catalyst used in the present

propellant formulation. The program is on schedule with respect to motors needed for missile deliveries to the B-1 Program. The primary risk associated with the motor program is seen as qualification of new facility and supplier, due primarily to the manufacturing and quality control discipline required by the complex, end-burning, pulse motor design.

Other Considerations

The present production planning noted other areas for consideration.

Specifications. Because of changes in the system, the follow-on SRAM configuration will be designated the AGM-69B. New specifications will be required because of changes in missile components and certain component interfaces and these new specifications will obviously be built around the AGM-69A baseline. However, the basic reason for generating new specifications is simply that the Air Force Systems Command has transitioned the AGM-69A system to the Logistics Command and no longer has any responsibility for this system or any control over the basic specifications.

Maintenance Concept. The maintenance concept for the existing SRAM weapon system calls for the missile to be checked out in a ground facility prior to upload in the carrier. After uploading, the integrated system is checked in a detailed system checkout. The B-1 employment concept will call for the missile system check to be completed on the ground with only a simple continuity/power-on check after upload. Implementing this change to the SRAM maintenance concept will require that the aircraft interfaces be simulated in the ground facility. The check-out equipment and facilities to support the "yellow airplane" requirement do not exist. The new maintenance concept can also affect the interchangeability of existing and

new configuration missiles with respect to use of ground support equipment and facilities. The deployment concept of the B-1 could also be affected if existing and new SRAM maintenance facilities are considered to be interchangeable.

Comparison of Planning

Present and initial Program Office planning is compared here on topics summarized from the initial planning documents.

Configuration. The present planning emphasizes the requalification of existing systems with changes where required because of non-availabilty of materials. Desirable changes are limited to component or sub-component level and are justified in terms of life cycle costs. Performance improvements are not being considered, even as a benefit from other changes. The increased memory capability of the new computer will be considered for enhancing maintainability rather than optimizing performance parameters. Effort is directed at meeting requirements as opposed to improving the system, which was emphasized in the earlier planning.

Verification Testing. The approach is unchanged from the earlier planning. The development and test of the software for the new system is thought to have some risk. The SRAM and B-1 flight test schedules are still compatible. The Program Office has reviewed the test program with the independent Air Force Test and Evaluation Center and that group has concurred in the structure of the program.

Replacement Rocket Motor. The Program Office feels that this program has low risk, due primarily to requalification rather than new motor

design. Risk would be that the supplier could not requalify in time to meet missile assembly schedules.

Nuclear Hardness. After investigation of this problem, the present planning emphasizes meeting the B-1 requirement. In initial design, the Program Office may seek higher levels than needed in order to be assured of attaining the B-1 levels in final design.

SRAM Warhead. This area is not defined at the present time, as noted in earlier discussion in this section. However, the Program Office is following the ERDA development work for the ALCM and TOMAHAWK missile programs. The earlier planning could not assess this area because of lack of information while the present planning is limited because of lack of program direction.

Program Direction. The present planning calls for a DSARC III.a production review for the SRAM for B-1 Program, subsequent to a production review of the B-1 Program. This review would provide a decision on system start-up. This would be followed by a DSARC III.b review in the fourth quarter of 1978 covering initial production deliveries and long lead for rate production. This is consistent with earlier planning.

Cost. The assumptions used in the cost planning have not changed from those used earlier. The planning now recognizes that the costs associated with the computer change, nuclear hardening of the system and modification of the missile/warhead interface will have to be absorbed during the start-up portion of the program.

Schedule. The initial planning anticipated some difficulty in meeting the early B-1 requirement for operational missiles. This situation has not changed in the later planning. Some initial shortfall of missiles is

forecast. The significance of this is debatable since the B-1 Program requirement is based on assumptions and ground rules with respect to system deployment and alert concept. However, these are essentially operational assumptions which are agreed to by the B-1 Program Office and system user and must be supported by the SRAM Program Office.

Risk. The updated planning of the Program Office now sees the program as having low risk, associated primarily with requalification of new components and suppliers rather than with any of the technology involved. The replacement motor program is seen as this kind of risk. The motor and computer software are thought to be the most critical areas of change. In the initial planning, risk was attributed primarily to adapting existing technology for use with SRAM. Hardening of the design against nuclear effects and development of a warhead/missile interface are felt to be low risk, although formal program direction concerning the latter has not been received. These areas were not assessed previously because of lack of information.

Summary

The present production planning has been simplified and concentrates on fewer issues. This is probably to be expected since any plan is improved by iteration with new information. It is interesting to note that the present plan emphasizes meeting requirements while the initial plan emphasized system improvement. The present plan has discontinued all investigations of potential system growth or improved performance. The initial planning included the option for such improvements. The present planning reflects known requirements while the initial planning had no

defined requirement except that new production was needed. While present planning has benefited from some definition of requirements, it is still limited by uncertainties with respect to the warhead and interchangeability of the follow-on SRAM with the existing configuration. The addition of a formal program review, such as a DSARC II, prior the production reviews presently planned, would have focused attention on these questions. However, given the sensitivity of the B-1 issue, it is doubtful that an early, high level review of the program would have been acceptable to higher headquarters.

SECTION V

CONCLUSIONS

The conclusions offered here are drawn from the discussion and comparison of the SRAM for B-1 production restart planning. They are not intended as an evaluation of the effectivenss of that planning activity but rather to form a basis for approaching a similar problem in the program management world.

Production Restart Must First Consider The Requirements

The follow-on production of a weapon system is intended to support a new application of the existing system, in a different environment and in a different time period than that under which it originally deployed. The requirements that the system must meet under the new conditions will be the major determinant of program office activities. The sooner these are defined, the sooner a credible plan can be formulated and progress made towards determining what the new configuration will be.

Production Restart is Concerned With Reproducing the Existing Design

Planning for follow-on production must recognize that an existing design was chosen for use with a new development because of its demonstrated performance and production delivery. Design effort prior to restart of production should be considered only to provide assurance that the production experience of the original program can be repeated in support of the

new application. Design effort can only be justified on the basis that it will make the new system easier and cheaper to build.

Production Restart Should Not Address Performance Improvement or Growth Potential

If a new requirement does not exist, the refinement of the existing design to improve such things as operational performance, maintainability and reliability is questionable. This is particularly true when the system is being used in a new application. Cost/benefit trade studies may show a positive gain; however, such studies use factors which are related to the new application. These factors are not completely defined and may change as overall planning proceeds which make study results less than conclusive. Modifying an existing design to add a growth potential or to add or enhance an existing capability implies that the system must meet some future requirement. Such speculation during the planning activity is a waste of time since, if the requirement should change in the new application, a totally new design would most likely be used.

Production Restart Will Involve Numerous Unknowns

The nature of this acquisition strategy, i.e. use of a completed weapon system with a new system development, implies that the programs will be in differing phases of acquisition which can put them far apart in time, particularly if development time of the new system is extended, as was true in the planning examined by this paper. This, plus the fact that all aspects of the new application may not be defined in detail, will result

in a great deal of uncertainty which must be recognized in the new production planning. This will require rethinking all elements of the previous program, reexamining all previous ground rules and rejustifying all assumptions. New production planning must also realize that the program can be affected by requirements, schedules, and ground rules over which it will have no control.

Production Restart Requires Planning and Review

Detailed planning, reiterated as new information becomes available from studies and through inputs from support agencies, will surface the pertinent issues and point out areas where decisions are needed. Production planning could be made more effective by a formal program review at a point well ahead of the first production review. Such a review would document known and potential problem areas. Only through thorough exposure of problems can the planning accumulate the detailed rationale to support needed decisions.

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